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(54) Light stabilisation of polymers

(57) The use, for the light stabilisation of polymers, of secondary alcohols or of their mixtures the boiling point of which is higher than the temperature for the treatment of the polymers, especially 1,2-propandiol, 1,4-pentadiol, 4-undecanol, dipropylene glycol, 2,9-decandiol.

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SPECIFICATION

Light stabilisation of polymers

5 The invention relates to a light stability agent for polymers, especially for polypropylene, polyethylene, polystyrene and for polymers containing chlorine, for example polyvinyl chloride and copolymers of vinyl chloride.

10 Industrially produced polymers, especially polyvinyl chloride, cannot be treated, and especially not applied, without effective stability systems as they depreciate very soon. First of all, a change of colour takes place during aging, the relative molecular mass changes as well as mechanical and electrical characteristics, eventually a loss or decay of softening agents takes place.

The main cause of depreciation of plastics products, especially in the course of external application, is due to light radiation. Photo-oxidising reactions are accompanied, on the one hand, by the rise of low-molecular products, on the other hand by the rise of oxidation structures on a polymer chain. Carbonyl groups are contained in the polymer already before the exposure. By the effect of light radiation, their quantity increases and they influence negatively the light resistance of polymers. One of the ways of stabilising polymers in the course of natural weathering is to use absorbers of ultraviolet radiation. These are mostly complicated organic compounds used in an amount of 0.1 to 1 %, exceptionally of up to 2 %. They are, for example, substances of the benzophenone and benzotriazole type, saltcylates, substituted acrylonitriles and certain colouring agents which are able to absorb the ultraviolet radiation. For the most part these substances are not easily accessible and the technology of their preparation is relatively intricate.

40 The cited disadvantages are avoided by the use of secondary alcohols or their combinations the boiling point of which is higher than the temperature for the treatment of the mixture containing polymer with other used additives, especially 1,2-propandiol, 1,4-pentadiol, 4-undecanol, dipropylene glycol, 2,9-decandiol, used for the light stabilisation of polymers, especially for polypropylene, polyethylene, polystyrene and for polymers containing chlorine, especially polyvinyl chloride and copolymers of vinyl chloride in the amount of 0.1 to 5.0 mass parts for 100 mass parts of polymer.

Other used additives are for example antioxidants, filling agents, lubricants, softening agents, modifiers and burning retarders.

55 The effect of the stability agent is manifested by a higher colour stability of the plastics material during application, by reducing carbonyl groups contents in the polymer chain, by reducing the decrease of molecular mass of the polymer and by reducing the decrease of the mechanical characteristics of the plastics material.

The evaluation of the stabilising effectivity of the light stability agent according to the invention was executed under conditions of natural weathering in an exposure station in Czechoslovakia and under

conditions of accelerated weathering by the increase of ultraviolet radiation in the zone of 290 to 420 nanometres. The course of the photo-oxidation and the colouring evolution of the exposed samples was followed spectrographically by measuring the carbonyl groups content and the double bonds of polymer, in the case of polyvinyl-chloride also by reducing the contents of the hydrogen chloride in the exposed mixture.

70 The contribution of the invention lies in the fact that, using secondary alcohols for the stabilisation of polymers according to the invention, reduction of the carbonyl groups creation, better colour stability, reduction of the decrease of molecular masses and of the mechanical characteristics of polymers are achieved in comparison with an unstabilised polymer.

The invention is more clearly described in the following examples of real executions.

Example 1

100 mass parts of polyvinyl chloride and 1.0 mass part of 1,4-pentadiol were mixed in a mixing mill at 160 °C for 2 minutes. The calendered foil was pressed to a thickness of about 100 micrometres. During an accelerated weathering of the polyvinyl chloride foil without any stability agent, the contents of carbonyl groups increased 10 times after 380 hours of exposure. In the foil with the light stability agent, the same increase of carbonyl groups was achieved after 550 hours. The polymer with the light stability agent had a better colour stability in course of photodegradation.

Example 2

100 mass parts of polyvinyl chloride and 2.0 mass parts of 1,4-pentadiol were mixed in the same way as in Example 1. During an accelerated weathering of polyvinyl chloride without any light stability agent, the molecular mass (mass middle) decreased from the beginning of photodegradation so that after 700 hours it decreased by 25 %. In the foil with the light stability agent, a ten multiple increase of carbonyl groups is achieved until after 700 hours of exposure; the value of molecular mass is 300 hours constant, after 700 hours of photodegradation it decreases by 10 %. The polymer with the light stability agent has a better colour stability in course of photodegradation.

Example 3

100 mass parts of polyethylene and 1.0 mass part of 1,2-propandiol were mixed in the mixing chamber of a Brabender plastograph at 160 °C for 4 minutes. The obtained mixture was pressed to the thickness of about 100 micrometres. During an accelerated weathering of a polyethylene foil without any light stabilising agent, the carbonyl groups contents increased 4 times after 500 hours of exposure. During the test with the light stability agent, after the same exposure time only a double increase of carbonyl groups was achieved.

Example 4

100 mass parts of polyethylene and 2.0 mass

parts of 1,2-propanediol were mixed and treated in the same way as in Example 3. During an accelerated weathering of a polyethylene foil without any light stability agent, the carbonyl groups contents increased 4 times after 500 hours of exposure. During the test with the light stability agent, only a 1.5 multiple increase of carbonyl groups was achieved.

10 CLAIMS

1. The use for the light stabilisation of polymers of secondary alcohols or of their mixtures, the boiling point of which is higher than the temperature for the treatment of the polymers, in an amount of 0.1 to 5.0 mass parts per 100 mass parts of the polymer.
2. The use according to Claim 1 wherein the secondary alcohols are 1,2-propanediol, 1,4-pentadiol, 4-undecanol, dipropylene glycol and 2,9-decandiol.
3. The use according to Claim 1 or 2 wherein the polymers are polyolefins.
4. The use according to Claim 3 wherein the polyolefins are polypropylene, polyethylene, polystyrene and polymers containing chlorine.
5. The use according to Claim 1 or 2, wherein the polymers are halogen-substituted polyolefins.
6. The use according to Claim 5 wherein the halogen-substituted polyolefins are polyvinyl chloride and copolymers of vinyl chloride.
7. The use substantially as herein described with reference to the Examples.
8. A polymer light-stabilised by one or more secondary alcohols.
9. A polymer according to Claim 8 wherein the secondary alcohols are 1,2-propanediol, 1,4-pentadiol, 4-undecanol, dipropylene glycol and 2,9-decandiol.
10. A polymer according to Claim 8 or 9 wherein the polymer is a polyolefin.
11. A polymer according to Claim 10 wherein the polyolefin is polypropylene, polyethylene, polystyrene or a polymer containing chlorine.
12. A polymer according to Claim 8 or 9 wherein the polymer is a halogen-substituted polyolefin.
13. A polymer according to Claim 12 wherein the halogen-substituted polyolefin is polyvinyl chloride or a copolymer of vinyl chloride.
14. A light-stabilised polymer substantially as herein described with reference to the Examples.